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NOTES ON THE GENUS LEPTOPHRYS

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IN THE year 1869 Hertwig and Lesser published in the *Archiv für mikroskopische Anatomie* (Supplement zu Banden 1-8) an article entitled "Ueber Rhizopoden und denselben nahestehende Organismen." On page 57 of this volume they describe a new genus which they name Leptophrys. The following is their diagnostic description of this genus: "Body variable in form, sheet-like with processes put out, pointed and unbranched pseudopodia, which are chiefly found at the end of the processes; the parenchyma is filled with small non-contractile vacuoles nearly equal in size"; and though they saw but three bodies in a *single* individual which they took to be nuclei and failed to see nuclei in any other specimens, they add: "Nuclei in great number." The color or its absence in the "pearl-like" granules served them as a basis for distinguishing the two species, *L. cinerea* and *L. elegans*.

In December, 1904, I discovered in some water taken by Mr. William G. Lapham from an oozy bank near Afton, Virginia, a large Vampyrella-like specimen (Fig. 1), which except for the absence of nuclei and the variable size of the vacuoles answered in detail to *Leptophrys elegans*. In size the creature would cover a circular surface whose diameter was 80 micra. It was very active, constantly changing its form laterally, though dorso-ventrally it maintained a film- or sheet-like structure which was about 5 or 10 micra thick. The protoplasm was highly vacuolated by non-contractile vacuoles. The degree of vacuolation varied at different stages of vital activity. When most highly vacuolated the vacuoles approached equality in size. The body was also marked with numerous, more or less equal, "pearl-like" granules. The rather short, unequal, pointed, and unbranched pseudopodia were given off from the margin of the body. They contained no vacuoles nor refractive granules. When vacuoles and refractive granules were pushed out they formed processes which might bear one or more pseudopodia. Most of these were given off from an absolutely transparent marginal layer of protoplasm. Subsequently

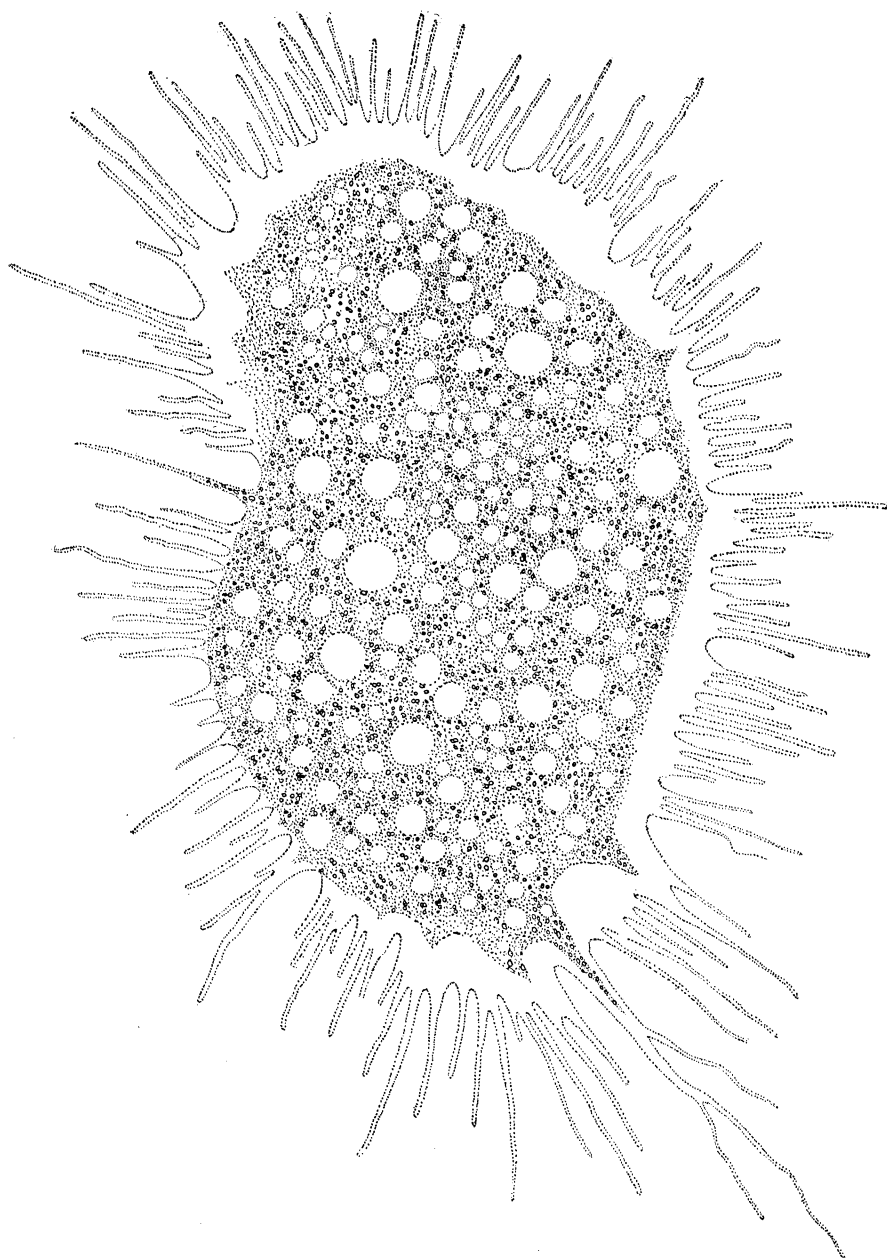


FIG 1.—Scale : 1 mm. = 1 micron.

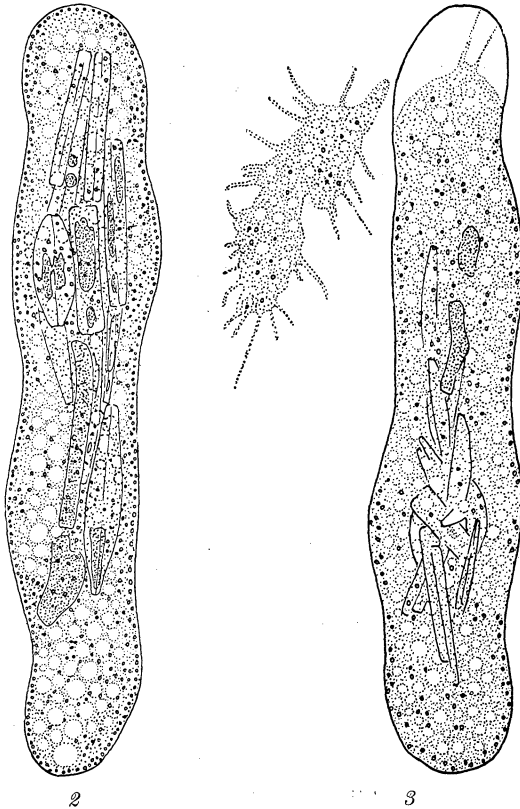
numerous specimens were found which did not show such a clear margin. Many specimens were seen which were quite free from food particles, but no staining of these would bring out a differentiation between the refractive granules and what might have been taken for nuclei. The figure of Hertwig and Lesser leads me to suspect that what they had taken for nuclei with central "nucleoli" were monads ingested as prey. It is unfortunate that they did not state how they determined these bodies to be nuclei.

Locomotion is effected by a more or less active amœboid movement. An active large individual tosses itself about very much as a cloud of smoke is distorted by a current of air. On the other hand the movement may be slow and deliberate.

The large individual represented in Fig. 1, took in as food diatoms, desmids, and what may have been several Infusoria. On March 22, 1905, in a bottle, that since March 12 had contained living *Chlamydomonas reticulata*, I found numerous specimens some of which belonged to *L. cinerea* and others which I had to place under the species *L. elegans*. They were feeding upon the Chlamydomonads. In one case I saw an individual that had ingested at least 25 Chlamydomonads. These flagellate forms after being ingested were greatly reduced in size. One specimen was found which had ingested a single *Navicula* sp. The ingestion of food was carefully observed. It was done, so far as could be seen, just as an Amœba envelops its food, but the closing of the ectosarc about the prey in the fashion of an iris diaphragm could not be made out. The food appeared to be partially digested while the animals moved about. This inference is based upon the broken-down appearance of the ingesta. The food is eventually assembled into a common vacuole more or less centrally disposed.

Some time after the animal has gorged itself with food, or formed a central common vacuole of food, it withdraws its pseudopodia and enters into an encysted condition. Numerous cysts have been seen and studied. A single individual has been observed ingesting food and was followed through its complete encystment. From the time when the animal had quieted down and ceased to ingest food to when it left the cyst, a period of five hours had elapsed. The cyst varies in size and shape, depending upon the size of the

animal and the amount and form of the food. When the food vacuole contains rounded bodies like *Chlamydomonads* the cyst is spheroidal in form (Figs. 5 and 6). One animal was seen encysted about a single *Navicula* sp. In this case the cyst was oval (Fig. 4); in Fig. 2 is shown an encysted individual which had

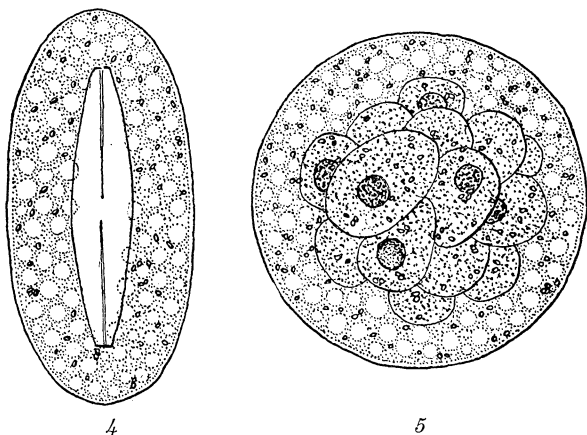


Figs. 2 and 3.—Scale: 1 mm. = 1.18 micra.

a food vacuole of numerous long bodies that determined an elongated cyst. The animals vary greatly in size. Fig. 1 represents an individual that is somewhat larger than the average; the cysts of course are found to vary as greatly in size.

Upon encystment the animal is colorless or nearly so (Fig. 5). During encystment a color is assumed in some cases, which seems to depend upon the character of the food that is being digested.

In cases where Chlamydomonads were being digested and reduced in size the food lost its green color and gradually became dark brown (Figs. 5, 6). As this proceeded the refractive granules and the protoplasm took on a brownish tint, which was evidently due to products of assimilation (Figs. 6, 7). On the other hand in two observed cases where diatoms, desmids, and Infusoria were being digested, no coloration was noted (Figs. 2, 4). During the early part of the encystment the vacuoles are not conspicuous. As the end of the encysted condition approaches the vacuoles become more prominent. The cyst may rupture at one, two, three, or four places, and the contents escape through the clefts. In the

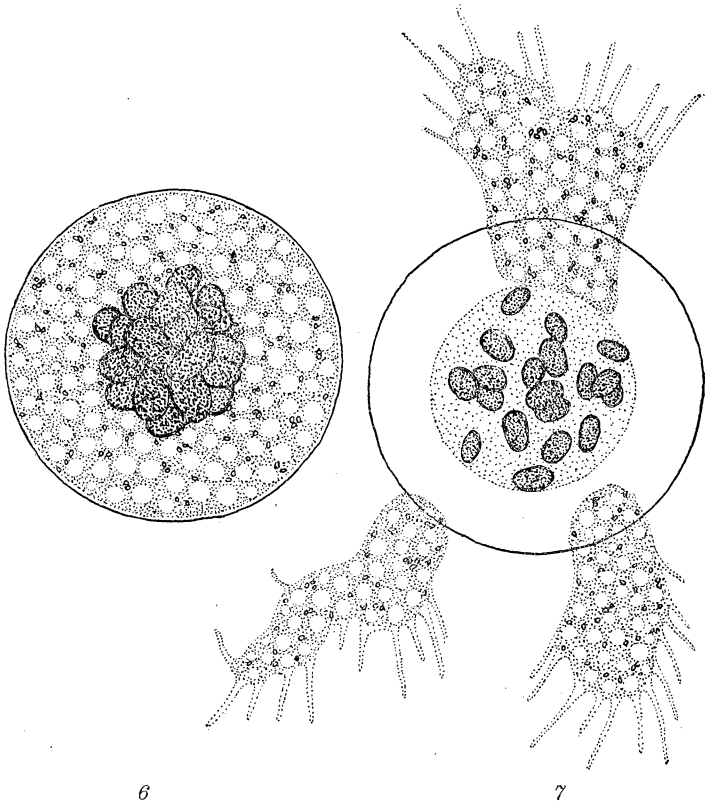


FIGS. 4 and 5.—Scale: 1 mm. = 1 micron.

large cyst shown in Fig. 3 the protoplasm streamed out at a cleft in the apparent upper right hand corner of the cyst. As the protoplasm flowed out it broke accidentally into four greatly unequal portions. Each part, though no two were equal in size, became a complete individual. These daughter individuals were almost colorless. In the forms that had been feeding upon Chlamydomonas the contents emerged at two, three, or four clefts in the cyst membrane (Fig. 7). In all these cases the daughter individuals came out of the cyst colored *light brown*. As they lived an active life their color decreased. Beneath a single cover-glass all degrees of coloration were easily found. The transparent ones answered to Hertwig and Lesser's description for *L. elegans*. The

brown ones as they leave the cyst, I take to be their *L. cinerea*. In as much as they had not seen any specimens ingest food and had observed no encystment I am led to believe that what they studied and described as two species were but different nutritive conditions of individuals of the same species.

In November, 1904, Mr. Lapham observed a large colorless



FIGS. 6 and 7.—Scale: 1 mm. = 1 micron.

individual divide into daughter parts of protoplasm to each of which the food enclosures had been equally distributed. In March, 1905, I observed one of the individuals found living with *Chlamydomonas reticulata* divide into daughter forms. The process was rather slow. It began with the formation of two fan-shaped parts, connected by a wide neck (Fig. 8). This neck became more and

more attenuated until at the end of 35 minutes there was the merest strand of protoplasm connecting the two parts, which had now moved 500 micra apart. This strand suddenly snapped and the fragments moved away as two new individuals. While this process was going on one of the parts ingested a *Chlamydomonas*. Except for this there was not a trace of ingesta within the dividing protoplasm.

These observations seem to afford reasons for setting aside Hertwig and Lesser's two species, *L. cinerea* and *L. elegans*; and the fact that, although there was ample opportunity to demonstrate nuclei such as Hertwig and Lesser describe as seen in part of a single individual, no evidence of their presence was obtained, leads to the conclusion already suggested by Penard that the genus *Leptophrys* is but a synonym for a species of *Vampyrella*.

The variation in the form of the cysts of this *Vampyrella* and the two cases of binary fission, independently observed by Mr. Lapham and myself in this species, are of interest. Attention is also called to the

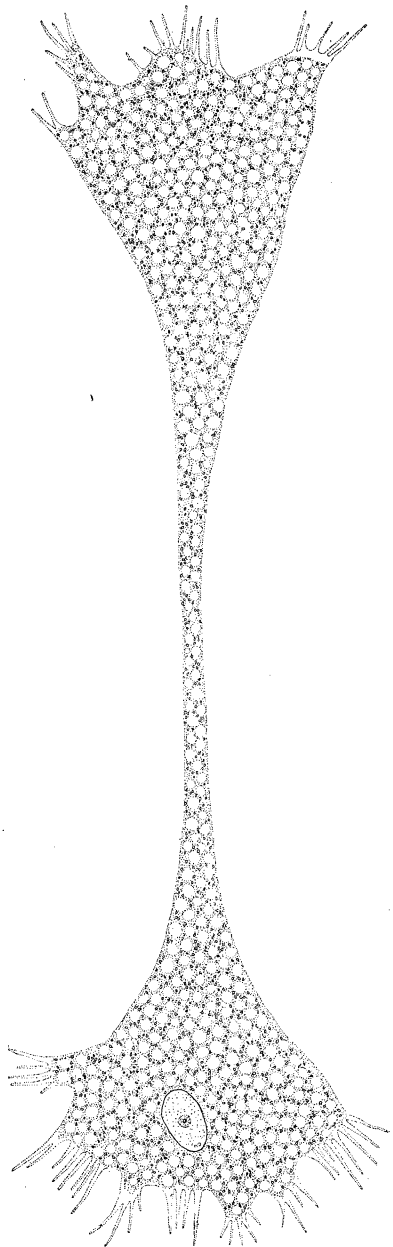


FIG. 8.—Scale: 1 mm. = 4 micra.

apparently accidental division of protoplasm that takes place where there is no centralized nucleus.

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